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SCIENCE

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THE GOOD ENGINEERING TEACHER, HIS PERSONALITY AND TRAINING¹

At the meeting of Section E on Engineering Education of the World's Engineering Congress which was held in Chicago in 1893 in connection with the World's Columbian Exposition, there were assembled "seventy or more" engineering educators from the United States and eight or more foreign countries. This society owes its existence to the congress and to the thought and labors of Professor Ira O. Baker, chairman of the Division Committee, and Professor C. Frank Allen, its secretary *pro tem*. Of the seventy charter members, twenty-nine have either gone to their reward or have withdrawn from the society. Only forty-one of the seventy are now members of the society. Eleven of the living past-presidents are charter members, three became members in 1894, and one each in 1895, 1897 and 1902. That was twenty years ago. Some of us are no longer boys, even if we do feel as young and as full of enthusiasm as we did then. If time and your patience permitted it, and I were able, it would delight me to recall in great detail the lives and examples of some of the giants in engineering education whose successors we are—of the cultured Thurston, of that dynamic giant, DeVolson Wood, of that inventive genius, Robinson, of the courtly Chanute, of the erudite Johnson, and of the versatile Storm Bull. I offer you my congratulations on being allowed to follow where they have led the way.

But after twenty years of this society's

¹ Address of the President of the Society for the Promotion of Engineering Education.

existence for the promotion of engineering education, at this its twenty-first meeting, when our growth betokens that we have come to our legal majority, at least in years, I desire to lead your minds into the consideration of what is a good engineering teacher and to give you an appreciation of his personality, and what he is as I have seen him in three score and more of engineering colleges and technical schools.

What then is a good teacher? And my first answer is that he is one who knows enough of his subject to have something to impart. I sometimes think the reason men from the highest ranks of consulting engineers so frequently make poor teachers, from the point of view of the students, is that they know too much, and can not appreciate the fact that the students are down in the basement of the structure whose façade they are embellishing with artistic points of elegance and efficiency, and that the students are crawling on hands and knees along the path they are traveling with seven-league boots. In order that the teacher shall have something to impart, he should have had a proper education and some training, experience, travel and observation, as these are among the necessary qualifications for a good teacher. The man who has never earned his daily bread in the close commercial competition of the factory, works or mine, needs to learn one of the essential requirements of the successful engineering teacher, namely, to have rubbed elbows with workingmen of the artisan type and to have measured himself by their standards of knowledge and skill. One who has received only the education that he is trying to impart, possibly at his alma mater, probably in the same room in which he received it, who has never cut himself loose from his college's apron strings, and who has not taught or worked elsewhere, is not likely to make a good

teacher until he has been trained in the school of experience elsewhere. If graduate students should migrate for their best good, surely college teachers should do the same. In a previous paper before this society I have already referred to one institution, almost one hundred per cent. of whose teachers in one department are the educational offspring of the great mind which presided over the department for thirty years. Experience of any kind always serves a teacher well, and the more he has had of that which pertains to the subject that he is teaching, the better it will be for him and his students. Travel and inspection trips, to learn by observation how others are doing the same thing that he is expected to do, are extremely broadening and take him out of his natural groove. It is needless to say that continued reading and increase in one's knowledge of his profession is absolutely essential for the advancement of the good teacher.

A good teacher is one who can talk on his feet audibly enough to be heard without effort and intelligently enough to be understood without subsequent correction. For, if the listener can not hear what is being said for his instruction, both parties are wasting time which is more or less valuable. If the recipient of the instruction continuously fails to get an intelligent understanding of what has been said, he has no right to be in attendance; and, similarly, if the teacher continuously fails to give an intelligent understanding of what he is trying to say, he should be removed and not allowed to waste the valuable time of the students. A man who can not impart his knowledge can not be a good teacher. Hence, health, adequate previous rest and endurance are essential to the good teacher. Few of us, I think, appreciate the difference in the instruction given and taken in September and in May, on Monday and on

Friday, after a holiday spent in restful occupation and amusements and after an entertainment lasting until far past midnight. Some of us occasionally fail to consider and measure accurately the cash value of an hour of a class's time. We should be greatly disturbed if in our factory the power were needlessly shut off during the working hours of the day, or the lights went out at night, or the subsistence department failed to provide suitable food and lodging for our workmen, and we would at once discover the causes for this industrial inefficiency; but if the class is made to wait while a visitor or an assistant detains us, we may have little remorse, or indeed thought, concerning our academic inefficiency. To attend an engineering college it costs a student at least one dollar per week per credit hour of college work, or from sixteen to twenty dollars per week. If, therefore, the teacher in a college of engineering is absent without a substitute from a one-hour class-room engagement, it may be causing each of the ten to two hundred students to spend a dollar in needlessly trying to fulfil his part of the contract with the institution. The same is true of inexcusable latenesses.

A good teacher is one who has an unimpeached and deserved reputation for mental honesty, right living, patience under harassment and sound character. The engineering teacher who describes tricks of the trade, petty dishonesties, evasions of both the spirit and the letter of the law, without showing at least his disapproval of them, who shuts his eyes to dishonesties in class-room and college life, is neither a good teacher nor yet a good citizen. The teacher who is a leader in trickery, deceit and bluff during the term and who permits students to sit in an examination room so close together as to be under constant temptation to undesired dishonesty is *particeps*

criminis to any dereliction of the student then, and possibly later. When cheating in examinations is made a *sine qua non* for honor and high grades, if not for graduation, and when the most skillful compiler of invisible ponies and the most successful cheater becomes the honor man of the class, as I have heard reported in recent trips among the colleges, it would seem that an old-fashioned course in moral philosophy and ethics should be in order for both the teachers and the students. We all fail, I fear, frequently enough, but we should not be forced, or allowed, to fail inordinately. Occasionally we hear condonation expressed at the human frailties of the teacher, because he is considered as a genius in his specialty, and on account of his lovable qualities. Far be it from me to cast stones at my brother man, but I have never been able to discover a reason why a drunkard, or a libertine, should be tolerated in the teaching profession and frowned out of society in other professions and not allowed to work where the physical well-being of others was involved. Surely the mental and the spiritual well-being of our young men are paramount to their physical existence.

The one moral trait which seems to be most frequently demanded above all others from the teacher is that of patience. Some of us do not enjoy walking with persons who walk slowly or with very short steps, and who take a long time to get over very little ground. Similarly, we have to go equally slowly in expounding a new problem to a class, or in drawing out of even the average student the principle underlying the problem in hand, and in causing him to think about the subject consecutively and logically. We have all asked ourselves at the end of the hour, "How many in that class really took in the full significance of what I was talking about?"

If this is true with the average class, how much more is it so with those members who are lazy or are naturally slow in their mental operations?

From the above it follows as a matter of course that the good teacher should deserve the respect of his students and his colleagues as a man, as a teacher and as an engineer. I think it frequently happens that the students know our failings and our strong points better than we do ourselves, or than they are known by our superiors. Student criticism may sometimes be unjust for want of full and complete information, but it must be remembered that the young human mind is likely to be as keen in its perceptions as is the older mind of the man who occupies the other end of the room.

Another requisite in the good teacher is unbounded enthusiasm for and intense loyalty to the work of the teacher and of the engineer. We can tolerate the hireling in the commercial office and the drafting room, and the time-server may have to be put up with out on the works and in the mine, but the teacher, as a leader of young men and as a man who should be looked up to with some degree of that kind of respect which may grow into veneration should be so bubbling over with enthusiasm that it will be contagious.

That prince of cultured scientists, Dr. S. Weir Mitchell, in giving at the semi-centennial celebration of the foundation of the National Academy of Sciences some of his recollections of the eminent men of science whom he had known, told the story of Professor Joseph Leidy's being asked "if he never got tired of life." "Tired!" he said, "Not so long as there is an undescribed intestinal worm, or the riddle of a fossil bone or a rhizopod new to me." So, the enthusiastic teacher is never tired, so long as there is an intelligent boy to be trained or a mind to be developed. The engineer sets

in motion the wheels of thousands of machines; the successful educator sets in motion the wheels of a thousand minds. Such a man can always get the work out of his students, even if they have to curtail the time properly due to some other instructor who is less inspiring. The enthusiastic teacher never counts the cost to himself of his labor for those whom he loves to call "his boys."

I am of the opinion that our engineering colleges are less handicapped than are the academic colleges by the services of men who are teaching for a year or two either while studying for the bar or for holy orders, or to enable them to repay the debts contracted for their college education by the means which will permit the least effort during the shortest time. As a rule, the call to work in the bustle of the manufacturing and constructive world is preeminent in the mind of the engineering graduate. He is ready for the fray, and to-day he wants to get into it as never before, and no waiting until cooler weather or until after a summer vacation for him. "I am going to work next Monday," is his battle cry on commencement day. The courage of youth is beautiful to behold, and his zeal is a lesson to his teachers and to those who are following him.

Akin to enthusiasm for his work in the good teacher is his inspirational value to his students and his colleagues in the faculty. The former is the child of youth; the latter is the product of age and genius. When the teacher begins to lose his enthusiasm, he should begin to think that possibly he may be getting old, or else lazy. Not infrequently, however, the teacher who is devoid of enthusiasm may be of great inspirational value. He is the seer. He may be even halting in his speech, but by his ideas, his skill, or his manner of presenting the subject he may impress the stu-

dent with the greatness of the profession that he is studying and lead him on to larger visions. Fortunately, the world needs both draft horses and speed horses, otherwise some of them would have to be put out of the way. Similarly, it is a great comfort to some of us to think that possibly we are doing the work of the world for which we are created, even if we are not breathing out great ideas at every breath. All hail to the man, however, who has ideas and can cause others to adopt them, to lift the world up and into larger visions, and so to do bigger things for the benefit of mankind. Great men are not necessarily either enthusiastic or yet inspirational, and some of the poorest teachers under whom I have sat were great men in other lines of human endeavor. But I am sure we can all recall some one of our own teachers who was both a great man and a good teacher at the same time. But, may I not ask, was he not a good teacher because he was enthusiastic and inspirational, and had no thought of apologizing for being a teacher? The man who can never be a good teacher is he who is ashamed of his job, for to him it is most likely to be only the line of least effort to the pay-check.

The good teacher is he who has felt the thrill of having been called to the upbuilding of character in others, who day by day sees the unfolding of the innermost life of his fellow citizen, who has a life of service to live and enjoy, and who deals with human minds in the laboratory of life; for, after all, is not education only scientific research applied to character? Just as we go to the physician for improvement of the body, and to the priest for the betterment of the human soul, so we should go to the good teacher for the training in character which the young all need in different degrees. One of the inspiring sights of the college year and the one which always gives

me a genuine thrill of happiness is on commencement day to look over the sea of upturned faces of men and women who have just been graduated and feel that we have been in some small degree a party to their training and responsible for their future success in the battle of life and in the part that they will hereafter play, for weal or for woe, as our fellow citizens in this republic. In their promise of success is our joy and reward for a year of hard work. But for the joy of service, some of us would not be willing parties to what the governor of Ohio recently described as "the scandal of low salaries paid to college professors." I sometimes think that school boards and trustees occasionally take advantage of the idealism of the teacher to get his services below the proper market rate; and this is especially true of engineering teachers who in most cases can, and sometimes do, earn more money from their clients during a part of the year than they receive from their professorship during the major portion of the year. All the pay of the good teacher does not come inside the pay envelope. Much of it comes in that inward consciousness of work well done in the training for citizenship, for that efficiency which will prevent poverty, for success in whatever walk of life may be followed, and finally for the larger life here and hereafter. Some one has defined the professional class as the one that has no leisure, as instanced by the minister, the physician and the lawyer. Judged by that standard, we, as teachers, belong to the professional class.

Probably some of you have been wondering why I have not as yet said anything about the good engineering teacher being above all other things a good engineer. That goes almost without saying in this presence, provided you mean the *best* teacher. The engineering teacher who has

never practised anything that he has taught, who has never seen built anything that he has designed, who has never prepared for an elaborate test of some plant or machine and found that he had foreseen all the various requirements in the way of labor, apparatus and equipment, even to the board and lodging of himself and his assistants, can not expect to be considered as yet a really good engineering teacher. However, it must be remembered that as this is an educational society, and not an engineering or a technical society, as Dean Charles H. Benjamin has so aptly put it, so it must be remembered that the colleges need men who to be teachers must be first able to impart their knowledge, draw out from their students all that is in them, and cultivate in them the habits of correct thinking, clear vision, active imagination, sound reasoning powers, and good judgment; and because they possess these things themselves and can train others in them, they are therefore fit to be counted among the good teachers. It is for these reasons that good engineering teachers are said to be more difficult to find than are good teachers of other subjects.

A good engineering teacher must know what engineering really is. He must have clearly defined ideas on what are the distinguishing features of engineering; technical, manual training, trade school and industrial educations. He must have no half-hearted ideas as to where the engineering trades stop and where the profession begins. He must not be afraid to get out into the deep water of the profession of engineering. He must not believe that the proper engineering education is strictly utilitarian and vocational, and not one bit cultural. He must look between the folds of the ancient armor of his colleague in the college of arts of his institution, and discover that the scientific spirit has largely

superseded the literary spirit even in such subjects as Latin, Greek and the modern languages; that in fact in the work of some language teachers there is more of science than of language; that the so-called literary colleges are training men for vocations just as truly as are our colleges of engineering, law and medicine; that while the old-time classical colleges used to train men to be gentlemen, their successors in the educational world train men for journalism, insurance, politics, trade and business, as well as for education, the law and the ministry as heretofore. We engineers think that they are to be congratulated, in that they have enlarged their system of education and no longer make it so general as to fit the student for nothing in particular and so non-technical as to be useless except as a preparation for one of the professions.

"To know the best that has been thought and said in the world" is what Matthew Arnold calls culture. To the engineer, this is not the fullness of culture, but the rather to know the best that other men have thought, and said, and done. Even this is only half of the full duty of a cultured engineer. He should not only know the best that others have thought, and said, and done, but he should, as far as he may be mentally able, have contributed to the thought, and writings, and doings of the world. The engineering, above all other professions, demands that its members shall not be solely scholars, nor yet students of unsolved problems, but they shall have solved some of the problems which have pressed upon civilization for solution. Engineering teachers should be not scholars solely, nor yet students only, but pioneers and creators in the work of civilization. The first live in the spiritual palace called a library, where time, memory and the receptive faculties are alone required. The student lives in the laboratory where

the powers of observation are developed, logic reigns and laws are discovered. The successful engineer lives on the frontier of civilization, on the firing line of human endeavor, where those material problems have to be solved that have been set for the ages, and where the art of creation is wedded to the science of industry. The scholar deals with the past. The student lives in the present. The engineer looks into the future and solves its problems.

To be a good engineering teacher, one must be something of a scholar, student and creator and, highest of all, an educator capable of leading others to be the same. Such men are necessarily scarce, and while their financial rewards may be small, the satisfaction that they very properly get from their work transcends all their many self denials and enables them to hold their heads up with the world's best people.

This society was formed for the promotion of the kind of education which has been described. This is its twenty-first annual meeting. It may be now said to be of age. In closing this address I desire to leave with the next program committee and the incoming officers just two suggestions with the hope that they may be possible of adoption.

Let the program next year include a rousing session on "Education as a Science, rather than as an Art." Those of you who are familiar with the proceedings of the society know that we have had the subject of education considered as an art dealt with from many points of view. Until this meeting, little, if anything, has been done to consider the rationale and science of our chosen profession of education. Let the best minds in the educational world tell us, and in a practical way, all that time will permit concerning the science of education, including its psychology as applied to engineering education.

Schools of salesmanship have their special courses in the psychology of their chosen vocation; but did any one ever hear of a course in psychology being demanded as a part of the necessary training required for the engineering teacher? As training and instruction in the normal school are required of grammar-school teachers, and as graduation from a college of arts or of education is expected or demanded from the would-be high-school teacher, and since successful courses are given in our colleges of education on how to teach mathematics, chemistry and physics, surely courses are needed on how to teach the applications of these subjects. Hence I claim that some professional training in education should be required of the man who desires to impart his knowledge and to train young men for the practise of the engineering profession. We are engineering educators. Why should we be required to possess much professional knowledge and training in engineering and none in education?

And this leads me to my last suggestion, which is that the faculties of some of those universities which maintain colleges both of engineering and of education should offer in their summer terms strong courses of study in psychology and in education considered both as a science and as an art. These should be conducted by their most virile and experienced men, and college presidents, deans and heads of departments should be requested to influence their younger assistants and fresh graduates who expect to go permanently into the work of education to take these proposed courses of study in the summer term in preparation for their work in the college of engineering in the succeeding year. If this is done, more engineering teachers will become engineering educators.

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